

Organizations As Information Processing Systems

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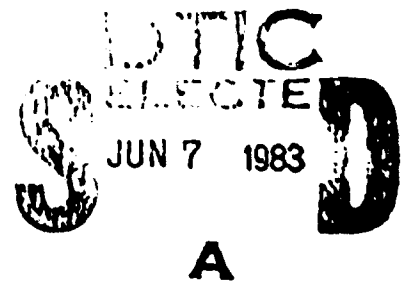
Information Richness:
A New Approach to Managerial Behavior
and Organization Design

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and
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TR-ONR-DG-02

May, 1983

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR-QNR-DG-02	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Information Richness: A New Approach to Managerial Behavior and Organization Design		5. TYPE OF REPORT & PERIOD COVERED Technical Report
7. AUTHOR(s) Richard L. Daft Robert H. Lengel		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS College of Business Administration Texas A&M University College Station, Texas 77843		8. CONTRACT OR GRANT NUMBER(s) N00014-83-C-0025
11. CONTROLLING OFFICE NAME AND ADDRESS Organizational Effectiveness Research Programs Office of Naval Research Arlington, VA 22217		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NR 170-950
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE May, 1983
		13. NUMBER OF PAGES
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approval for public release: distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Information Processing Managerial Behavior Equivocality Reduction Information Media Organization Design Communication Information Richness Organizational Communication Interpretation of Environment Organizational Coordination		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This paper introduces the concept of information richness, and proposes three models of information processing. The models describe (1) manager information behavior, (2) organizational mechanisms for coping with equivocality from the environment, and (3) organizational mechanisms for internal coordination. Concepts developed by Weick (1979) and Galbraith (1973) are integrated into two information tasks: equivocality reduction and the processing of a sufficient amount of information. The premise of this paper is that the accomplishment of these information tasks and the ultimate		

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20. ABSTRACT

success of the organization are related to the balance of information richness used in the organization.

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INFORMATION RICHNESS:
A NEW APPROACH TO MANAGERIAL BEHAVIOR AND ORGANIZATION DESIGN

Organizations face a dilemma. They must interpret the confusing, complicated swarm of external events that intrude upon the organization. Organizations must try to make sense of ill-defined, complex problems about which they have little or unclear information (Weick and Daft, 1982). Inside the organization, more confusion arises. Departments pull against each other to attain diverse goals and to serve unique constituencies and technologies (Lawrence and Lorsch, 1967). Divergent frames of reference, values, and goals generate disagreement, ambiguity and uncertainty. In response to the confusion arising from both the environment and internal differences, organizations must create an acceptable level of order and certainty. Managers must impose structure and clarity upon ambiguous events, and thereby provide direction, procedures, adequate coupling, clear data, and decision guidelines for participants. Organizations must confront uncertain, disorderly events from within and without, yet provide a clear, workable, well defined conceptual scheme for participants.

How do organizations perform this miracle? Through information processing. The design of organizations--even the very act of organizing--reflect ways to handle information (Galbraith, 1977; Weick, 1979). Managers spend the vast majority of their time exchanging information (Mintzberg, 1973). Specific dimensions of organization structure, such as functional or product organizational forms, and the use of teams, task forces or vertical information systems, all reflect information processing needs within organizations (Galbraith, 1973; Tushman and Nadler, 1978). Several papers

¹To appear in Research in Organizational Behavior, Vol. 6, Barry Staw and Larry L. Cummings (eds.), JAI Press, 1984.

have appeared in recent years which focus on information processing requirements as the explanation for observed organizational performance (Arrow, 1974; Porter and Roberts, 1976; Weick, 1979; Galbraith, 1977; Tushman and Nadler, 1978).

Consider, for example, the following information processing activities.¹

City Government. Late in the afternoon of March 13, 1980, a killer tornado bore down on the town of Elkhart, Oklahoma. The tornado cut a swath three blocks wide through the center of town. Everything in its path was destroyed. Several people were killed and scores were injured.

The city administration had prepared for the emergency. Four years earlier, the city council authorized development of an emergency plan. Working with a consultant, city department heads developed specific procedures to follow in the event of tornado, flood, explosion, or noxious gas. The procedures were similar to procedures that had solved emergencies in other towns. A national guard armory had been turned over to the city. Medical supplies were stored in the armory, along with food, water, sanitary facilities, and beds for people left homeless. A communication center to coordinate police, firemen, and utility departments was in one room. Equipment necessary for a temporary morgue was in another room. Space and personnel were allocated for counseling bereaved family members or others in a state of psychological disorientation. The city fathers had thought of everything.....almost.

The armory was in the path of the tornado. The armory was destroyed. Thirty minutes after the tornado struck, the Mayor realized a new plan would have to be developed from scratch. City councilmen, department heads and the firechief were all called to police headquarters. Individuals toured the community and reported back. The group stayed up all night

listening to reports of damage, discussing needs, setting priorities, developing alternatives, and assigning tasks. The administrators were emotionally distraught but by morning the injured had been found and delivered to hospitals, the damaged areas were secure, and a plan for the next week's activities was in place. City officials, working together, carved an excellent plan of action from an unpredicted emergency. They received high marks from townspeople and visiting officials for their effective response to the crisis.

Business College. A new dean was hired to run a large school of business in a major university in the Southeast. The dean initiated a plan to hold aside a portion of the salary increase money to be allocated on top of normal raises--called super raises--for the ten best producers in the college. The department heads met with the dean to recommend top performers from each department and to discuss their relative merits. The purpose of this meeting was to establish a common criterion of performance across departments and to select top performers.

The dean quickly realized that assignment of super raises was going to be difficult. Each professor's record was unique. How did a publication in a finance journal compare to a publication in a marketing journal? What was the contribution to knowledge of an article, and how was journal quality to be weighted? What was the role of teaching and student learning in the evaluation? The dean simplified the problem by asking department heads to summarize in a single page the record of each individual they recommended for a raise. Seventeen names were submitted with a one page summary of activities. From these the dean had to select ten. He found the decision impossible so he returned the sheets to the department heads

and asked them to rate all 17 people on a ten point scale. Professors with the highest average scores received the super raises. In essence, the complexity of each professor's record was first condensed onto a single page, and then into a single number. Several faculty members complained that the best performance in the college had not been rewarded. The following year, the dean and department heads devoted an entire day to discussion and analysis of performance records. Debate was lengthy and heated. Agreement was finally reached, and the outcome was acceptable to faculty members.

Retail Chain. Matthew B. was chief executive of a high fashion retail chain. The chain had 36 stores in 13 cities. Matthew B. hated formal reports. He preferred to discuss matters face-to-face and to reach decisions through consensus and discussion. Staying in touch required extensive travel. He visited stores to see what was selling and to get a feel for store design and layout. He had weekly breakfast meetings with top executives for discussion and planning. He also visited the company's plants and went to fashion shows to stay abreast of new trends.

Following a serious heart attack, Matthew B. retired and James N. became chief executive. He immediately acted on his belief in strong financial controls and precise analysis. He requested detailed reports and analyses for every decision. He relied on paper work and computer printouts for information. He cancelled the breakfast meetings and trips to plants, stores, and fashion centers. Personal contact with others was limited to occasional telephone calls and quarterly meetings. James N. argued that managing a corporation was like flying an airplane. Watch the dials to see if the plane deviates from its course, and then nudge it back with financial controls. Within two years, a palace revolt led

by a coalition of board members and vice-presidents ousted him as chief executive. They claimed that the chief executive had gotten hopelessly out of touch with the fast moving fashion environment.

The situations above illustrate ways organizations translate unexpected or complex problems into simpler, workable solutions. For the city of Elkhart, the ad hoc structure seemed to work well. Unclear events were interpreted and a workable course of action was developed. In the business college, the lengthy discussion used to evaluate faculty performance achieved a better outcome than the use of written descriptions or quantitative ratings. A similar thing happened in the retail chain. Management by discussion led to a more satisfactory outcome than managing by formal reports and paperwork.

Purpose of This Paper

The purpose of this paper is to propose new theoretical models that explain how organizations cope with the environment, coordinate activities, and solve problems through information processing, as illustrated in the above examples. The concept of information richness is introduced to explain how organizations meet the need for information amount and to reduce equivocality. The premise of this paper is that organizational success is based on the organization's ability to process information of appropriate richness to reduce uncertainty and clarify ambiguity. The concept of information richness is combined with other information concepts to provide an integrated view of the organization as an information processing system. The paper is divided into four parts.

1. The concept of information richness is presented in the next section and is used to integrate concepts from the information literature.

2. A model of manager behavior is then proposed based upon the congruence between information richness and information needs.
3. Next, a model of organizations as information processing systems is proposed. Organizations have two information problems to solve, that of interpreting the environment and that of coordinating diverse internal activities. Models based on information richness explain how organizations such as the Elkhart city government and the business school described above resolve both interpretation and coordination needs.
4. Finally, traditional organization concepts, such as bureaucracy, politics, and organic structure are reinterpreted to show how they are associated with richness of information processing. Suggestions for future research are also explored.

DEFINITION OF INFORMATION RICHNESS

Daft and Wiginton (1979) proposed that human languages differ in their ability to convey information. The concept of language was used in the broadest sense to encompass various ways to transmit ideas, emotions, and concepts. High variety languages are those in which symbol use is not restricted and the language can communicate a wide range of ideas. Examples include art, music, and painting, which are subjective in interpretation. Low variety languages have symbols that are restrictive in their use, and the languages communicate a narrower range of ideas. Low variety languages include mathematics and statistics, which convey exact, unequivocal meaning to users. Daft and Wiginton argued that high variety languages were appropriate for communicating about difficult, ephemeral, social phenomena. Low variety languages communicate effectively about well understood, unambiguous topics.

The notion of language variety seems plausible, but it doesn't explain information processing in organizations. Managers typically don't use art, poetry, or mathematics to communicate about organizational phenomena. The range of language used within organizations is typically limited to natural language and simple numbers.

Lengel (1983) proposed a continuum of information richness to explain information processing behavior in organizations. Richness is defined as the potential information carrying capacity of data. If the communication of an item of data, such as a wink, provides substantial new understanding, it would be considered rich. If the datum provides little understanding, it would be low in richness.

Lengel (1983), building upon the work of Bodensteiner (1970), argued that communication media used in organizations determines the richness of information processed. He proposed that communication media vary in the richness of information processed. Moreover, communication media were proposed to fit along a 5-step continuum, as in figure 1. Communication media include face-to-face discussion, phone calls, letters, written documents and numeric documents. The face-to-face medium conveys the richest information while formal numeric documents convey the least rich information.

(Figure 1 about here)

The explanation for the hierarchy of media richness is contained in figure 2. Each medium differs in (1) feedback capability, (2) communication channels utilized, (3) source and (4) language (Bodensteiner, 1970; Holland, Stead, and Leibrock, 1976).

Face-to-face is the richest form of information processing because it provides immediate feedback. With feedback, understanding can be

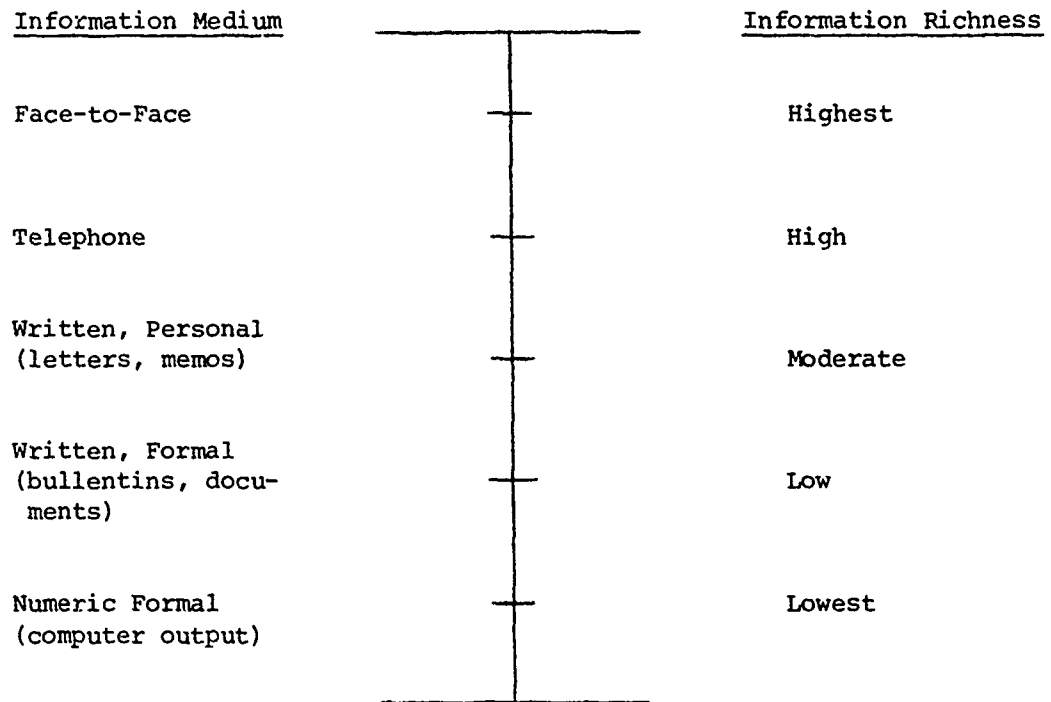


Figure 1. Communication Media and Information Richness.

checked and interpretations corrected. The face-to-face medium also allows the simultaneous observation of multiple cues, including body language, facial expression and tone of voice, which convey information beyond the spoken message. Face-to-face information also is of a personal nature and utilizes natural language which is high in variety (Daft and Wiginton, 1979).

(Figure 2 about here)

The telephone medium is somewhat less rich than face-to-face. Feedback capability is fast, but visual cues are not available. Individuals have to rely on language content and audio cues to reach understanding.

Written communications are less rich still. Feedback is slow. Only the information that is written down is conveyed so visual cues are limited to that which is on paper. Audio cues are absent, although natural language can be utilized. Addressed documents are of a personal nature and are somewhat richer than standard flyers and bulletins, which are anonymous and impersonal.

Formal numeric documents are lowest in information richness. An example would be quantitative reports from the computer. Numbers tend to be useful for communicating about simple, quantifiable aspects of organizations. Numbers do not have the information carrying capacity of natural language. These reports provide no opportunity for visual observation, feedback, or personalization.

One value of the richness hierarchy in figures 1 and 2 is that it organizes a diverse set of information concepts. For example, previous research has been concerned with information sources such as human versus documentary (Keegan, 1974), personal versus impersonal (Aguilar, 1967),

Information
Richness

High



Low

Medium	Feedback	Channel	Source	Language
Face-to-Face	Immediate	Visual, Audio	Personal	Body, Natural
Telephone	Fast	Audio	Personal	Natural
Written, Personal	Slow	Limited Visual	Personal	Natural
Written, Formal	Very Slow	Limited Visual	Impersonal	Natural
Numeric, Formal	Very Slow	Limited Visual	Impersonal	Numeric

Figure 2. Characteristics of media that determine richness of information processed.

and such things as files, formal reports, or group discussions (O'Reilly, 1982; Kefalas, 1975). The richness continuum makes sense of these differences, and may explain source utilization. Each medium is not just a source, but represents a difference in the act of information processing. Each medium utilizes differences in feedback, cues and language variety. Richness is a promising concept for understanding information behavior in organizations. In the next section, we show how information richness explains the information processing behavior of managers.

MODEL OF MANAGERIAL INFORMATION PROCESSING

Organizational phenomena confronting managers can vary from simple to complex. Simple phenomena tend to be mechanical, routine, predictable and well understood. Simple phenomena mean that managers typically can follow an objective, computational procedure to resolve problems. When phenomena are complex, however, no objective, computational procedure tells the manager how to respond. These issues are difficult, hard to analyze, perhaps emotion laden, and unpredictable. Managers have to spend time analyzing the situation and thinking about what to do. They will search for information and solutions outside normal procedures. Simple versus complex problems are similar to what Thompson (1967) called knowledge of cause-effect relationships and what Perrow (1967) called analyzability. Managers often experience difficulty seeing into complex tasks to analyze alternative courses of action, costs, benefits, and outcomes.

The proposed role of information media in manager information processing is presented in the framework in figure 3. Figure 3 illustrates that rich media are needed to process information about complex organizational topics. Media low in richness are suited to simple topics. The mechanical side of the organization is normally simple and measureable. Factors such as inventory control or employee attendance are not difficult to conceptualize. Managers can communicate about these phenomena through paperwork and quantitative reports. Other variables, such as organizational goals, strategies, managerial intentions or employee motivation, are intangible. These factors are not clear and discreet, and they can be difficult to interpret. Making sense of these factors requires a rich medium that provides multiple information cues, immediate feedback and a high variety language. Rich in-

formation enables managers to arrive at a more accurate interpretation in a short time.

(Figure 3 about here)

The framework in figure 3 hypothesizes a positive relationship between information richness and the complexity of organizational phenomena. Managers will turn to rich media when they deal with the difficult, changing, unpredictable human dimensions of organizations. Rich media enable them to communicate about and make sense of these processes. Face-to-face and telephone media enable managers to quickly update their mental maps of the organization. Rich media convey multiple cues and enable rapid feedback. Less rich media might oversimplify complex topics and may not enable the exchange of sufficient information to alter a manager's understanding. For routine problems, which are already understood, media of lower richness would provide sufficient information.

The figure 3 framework is a significant departure from the assumption that precise, clear information is best for managers. Memos, reports and other written media can oversimplify complex problems. They do not provide a means to convey personal feelings or feedback. These media do not transmit the subtleties associated with the unpredictable, messy, emotional aspects of organizations. On the other hand, extensive face-to-face meetings for simple phenomena may also be inefficient. Face-to-face discussion sends a variety of cues, which may not always agree with one another. Facial expression may distract from spoken words. Multiple cues can distract the receiver's attention from the routine message.

This model, if correct, begins to explain why top managers make little use of formal information in organizations. Managers thrive on informal, personal communications (Mintzberg, 1973). The retail chain chief execu-

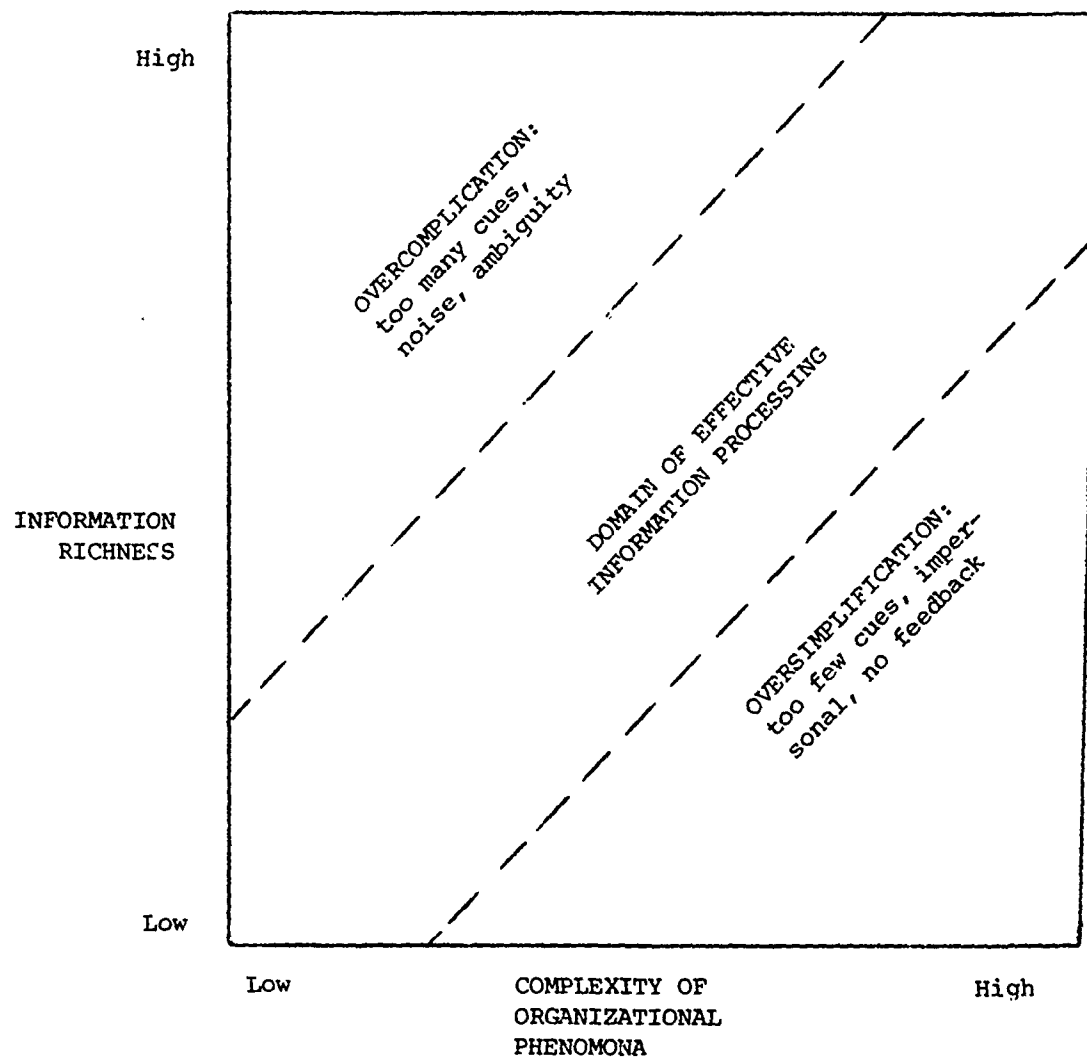


Figure 3. Model of manager information processing.

tives described earlier in this chapter illustrates the role of information media. The executive who used rich media such as store and plant visits, breakfast meetings and phone calls kept well informed on myriad environmental and company issues. The executive who relied on formal reports and financial data got behind and out of synchronization with events. Face-to-face and telephone media, with multiple cues and rapid feedback, are needed to help top managers deal with the complex issues confronting them.

Management scientists, operational researchers, and other staff specialists are frustrated when managers ignore formal reports, systematic studies, and standard procedures. The model in figure 3 explains why. Those media only work for certain tasks. The reason managers often ignore these sources of information is not personal ignorance, lack of training, or personality defect. Informal, personal media simply are capable of providing richer information to managers about certain problems. Manager behavior reflects an intuitive understanding of how to learn about things. Many management problems are difficult and complex; hence formal information is not rich enough to convey adequate insight and understanding. Personal sources are more insightful. Manager information processing behavior makes sense after all.

Research Evidence

Mintzberg's (1973) observation of top managers indicated that each manager is the nerve center for an information network. Managers have extensive contacts both within and outside the organization. They are plugged into channels for rumor and gossip, and are surrounded with formal information systems that provide periodic summaries and analyses of organizational activities. Managers spend over eighty percent of their time communicating.

In this section we will review studies of information processing in organizations to determine whether previous research supports the figure 3 relationship between media selection and problem complexity. This review is organized into three parts: (1) information sources, (2) mode of presentation, and (3) the use of management information systems.

Information sources. Observations of managers indicate a strong preference for the verbal media. They prefer face-to-face meetings and the telephone. Mail and technical reports are used less frequently (Mintzberg, 1972, 1973). Managers prefer current information and move away from formal reports and quantitative documents.

The information sources observed by Mintzberg represent differences in media richness. Face-to-face and telephone are rich and enable managers to process information about intangible activities. Mail and formal reports are less rich, and usually pertain to well understood aspects of the organization. The majority of manager information is processed through rich media because organizations are often fast changing, and many of the manager's responsibilities pertain to the social, emotional and poorly understood aspects of organization. Our model is consistent with and explains manager behavior such as observed by Mintzberg (1973).

A study by Holland, Stead, and Leibrock (1976) comes closest to evaluating the figure 3 model of manager information processing. They proposed that individuals working under high uncertainty would use richer media to transfer information than would individuals dealing with relative certainty. Holland, et al gathered questionnaire data from R&D units, and found that interpersonal channels of communication were important when perceived uncertainty was high. They also found a positive relationship

between level of uncertainty and the reported usefulness of information sources. Holland, et al concluded that managers experiencing uncertainty should be encouraged to use rich sources of information, even if it meant making long distance telephone calls or traveling. High rich media enabled participants to learn about complex topics in a short time. Written information sources, such as the professional literature and technical manuals, were preferred when task assignments were well understood.

A study by Blandin and Brown (1977) looked at the search behavior of managers. They examined external, formal, and informal information sources and related these to environmental uncertainty. As the level of perceived uncertainty increased, managers relied more heavily on external and informal sources of information. The frequency and amount of time spent gathering information also increased. Thus both the richness and amount of information increased with perceived uncertainty.

Although only a few studies have compared information source to topic complexity, the findings above do suggest that richer sources tend to be used when managers confront uncertain or complex topics. Less rich sources of information tend to be preferred when issues are well understood and routine. In general, the pattern of findings supports the positive relationship between media richness and task complexity proposed in the manager information processing model.

Mode of Presentation. Research into the mode of presentation typically presents data in two or more forms to learn how it is perceived and acted on. Nesbitt and associates found that case illustrations have stronger impact on people's judgement than hard data (Borgada and Nesbitt, 1977; McArthur, 1972, 1976; Nesbitt and Ross, 1980). O'Reilly (1980) concluded

that humans are more influenced by vivid, concrete examples than by dry statistics, even though statistics represent more systematic evidence from multiple observations. Other studies report that statistical data do have impact, but the case example gets more weight in decisions that appear to be objectively rational (Azien, 1977; Feldman, et. al., 1976; Hansen and Donohue, 1977; Feldman and March, 1981; Manis et. al., 1980). In a series of studies, Martin and Powers (1979, 1980a, 1980b) provided recipients with written statistical data and with a verbal story to assess which information swayed policy decisions. Stories tended to have more impact. They concluded that organization reality is not objective, therefore statistical data pretend to report on objective reality which does not exist in the mental model of managers. Statistical data did tend to be influential when used to refute or overturn organizational policy. More precise evidence thus may be required to overturn a decision, while qualitative, story based evidence is sufficient to support current policies.

Several studies show a strong preference for oral modes of information transfer. Mason and Mitroff (1973) argued that mode of presentation influences information preference. Landendorff (1970) found that interpersonal modes were preferred to written communication because interpersonal modes can be refined, adapted and evaluated to precisely fit the problem. Generally, oral information allows for rapid feedback and resolution of complex problems, and is often easier to access. The importance of oral communication, especially face-to-face, is reflected in the impact of nonverbal signals. Eye contact, body movement, and facial expression communicate meaning beyond the verbal message. In one study of face-to-face communication, only seven percent of the content was transmitted by verbal language.

The remaining ninety-three percent of information received was contained in the tone of voice and facial expression (Mehrabian, 1971). A sarcastic versus enthusiastic tone of voice conveys as much meaning as the specific statements processed between managers.

Management Information Systems. Management information systems tend to be on the low end of the richness continuum presented in figure 1. Most MIS's are formal and use quantitative or written reports.

Many studies designed to evaluate the usefulness of management information systems have attempted to operationalize economic value. Subjects purchase data and make simple decisions. These studies are not very helpful to understanding manager behavior because they employ naive assumptions about how managers use information. These studies are typically conducted in the laboratory, using sterile decision tasks and sterile information. The array of information cues typically available to managers are absent. The generality of these studies is extremely questionable (O'Reilly and Anderson, 1979).

Perhaps the most widely accepted conclusion is that computer-based management information systems are not very useful to managers. The efforts to implement and use these systems have fallen short of providing maximum effectiveness and efficiency (Ackoff, 1976; Deardin, 1972; Larson, 1974; Grayson, 1973; Leavitt, 1975). A number of factors have been cited to explain MIS failures. Management information systems provide data about stable, recurring, predictable events. MIS's provide data that skim over the nonquantifiable detail needed by managers. Management information systems supply quantifiable data. These data do not provide insight into the intangible, social dimensions of organization.

Brown (1966) noted that information needs may depend upon level of decision. At the operational level in organizations, where decisions pertain to routine technical problems, decision support systems may have greater value. Several other studies support the conclusion that management information systems are most relevant to those managers who work with well defined operational and technical decisions (Dearden, 1972; Dickson, Senn, Cheway, 1977).

A survey of fifty-six organizations in England by Higgins and Finn (1977) examined attitudes toward management information systems. While computer reports could be useful, they found intuitive judgement was used more often than computer analysis in management's strategic decisions. Executives typically drew on a variety of sources of information, weighing each for importance, and then making a final decision. Computer based data could play a role in these decisions, but a small one.

The small role of management information systems is not completely understood, but the primary reason seems to be that they do not convey information that meets manager's needs. MIS's work under the assumption that managers need large amounts of precise data. As managers receive more and more data they should be able to solve their problems, which is not the case (Ackoff, 1967).

Tushman and Nadler (1977) believe that information designers are more concerned with fitting data to their hardware than with understanding the overall information needs of managers. Information system designers lack a theory about manager needs and behavior. By limiting data to those things amenable to machine hardware, information designers miss the root causes of manager information processing. Most manager tasks are too ill-defined for

quantitative data, yet system designers assume that computer output is sufficient for management decisions. MIS systems are able to capture and communicate about the stable, predictable activities, but not about the important, subjective, ill-defined events relevant to decision making.

Summary. The pattern of findings about manager information processing tend to support the notion that information richness is a useful explanation for information behavior. Only a few studies have examined manager utilization of various media, or have related media to specific tasks (Lengel, 1983). Available findings suggest that managerial behavior does reflect media choice based upon the uncertainty or complexity of management problems. When managers work in a highly uncertain context, they rely more heavily on rich media. These media provide a variety of information cues and immediate feedback to interpret and understand the situation. Managerial jobs are fast paced and fragmented, hence they often need to learn about a fuzzy situation quickly. Rich media serve this purpose.

Media of low richness, including formal information systems, seem best suited to well understood management issues. These media are used more often at the bottom of the organization and for problems that are considered objective and quantifiable. The evidence from the literature generally supports the theoretical model of manager information processing presented in figure 3. Managers use all media within the organization, and probably should be skilled with each one. Managers move toward rich media for information about difficult problems. They prefer rich media because it meets the information needs associated with the manager's job.

MODELS OF ORGANIZATIONAL INFORMATION PROCESSING

In this section we shift levels of analysis from the individual manager

to the organization as a whole. Within organization theory, two theoretical perspectives have had significant impact on the conceptualization of information processing within organizations. These models pertain to what we call the vertical and horizontal information processing needs of organizations.

Two Perspectives

Vertical. The first theoretical view was developed by Karl Weick (1979). Weick focused on the concept of information equivocality. When managers observe or learn about an external event, the information cue is often ambiguous. Managers are unclear about what the event means or how to translate it into organizational action. Weick proposed that organizations are designed to reduce equivocality from the environment. Organizing is the construction of a consensually validated grammar for reducing equivocality (Weick, 1979, p. 3). This means that when managers are confronted with equivocal cues, they must discuss the issue among themselves and gradually arrive at a common interpretation and frame of reference. The equivocality is reduced to an acceptable level, and the common interpretation is then used within the organization. The common interpretation becomes the basis for future action.

Weick's notion of equivocality is intriguing because it demonstrates that organizations must do more than process large amounts of information. Organizational environments can be confusing, impenetrable, and changing. Organizations cannot tolerate too much ambiguity. Organizations must cope with equivocal cues in a way that reduces equivocality to an acceptable level so that the organization can take action and get things done. The equivocal stimulus triggers information processing within the organization that leads to greater certainty and clarity for participants. Organizations,

then, must interpret ambiguous stimuli and reduce them to sufficient clarity for action within the organization. Weick identified this as an important problem that organizing must solve. By processing equivocal information into an agreed upon interpretation, participants can decide what to do. The organization can be reasonably clear about what it is doing and where it is heading.

Horizontal. The other view of information processing was developed by Jay Galbraith (1972; 1973). Galbraith proposed that as the level of uncertainty for managers increased, the amount of information processed should increase to reduce uncertainty. Galbraith argued that the uncertainty confronting an organization was influenced by factors such as diversity, task variability, and interdependence. Diverse products, or goals means the organization must process a large amount of information to operationalize and monitor a number of activities. When task variability is high, managers confront unexpected events, so they must process additional information to learn about these events and thereby reduce uncertainty. Interdependence refers to the connectedness of departments. When the activities of one department influence other departments, information must be processed between them to provide the coordination needed for high performance.

The insight provided by Galbraith is that the amount of information processed within the organization explains why certain organizational forms are effective. By diagnosing points of uncertainty confronting the organization, a structure can be implemented that encourages appropriate information exchanges. When interdependence between departments is high, mechanisms can be designed to pass information between those departments. Likewise, when task variability is high, a structural design can be adopted to enable

managers to acquire information in response to unexpected events. The selection of an overall structural form, such as product, function, or matrix, reflects the information processing needs of the organization. Each form directs the flow of information within the organization toward the points needed for effective performance. Galbraith provided a framework that explains the amount of information needed within the organization for effective performance. He also described how organizational design provides the correct amount of information where it is needed throughout the organization.

Interpretation vs. Coordination

Weick's theory of equivocality reduction pertains to the interpretation needs of organizations, which is the vertical dimension of information processing. Organizations interpret an ill-defined environment and define with some certainty a course of action for participants. Top managers are involved in the interpretation process. They read cues and then define goals, products, structure, strategy and technology. The vertical dimension of organizational information processing is top down. Upper level managers reduce equivocality to a level acceptable to others within the organization.

Galbraith's discussion of information amount pertains to information for internal coordination, the horizontal dimension of information processing. Horizontal information processing occurs within organizations to coordinate and execute organizational activities. Information is processed as needed for the organization to perform as a coordinated whole. Environmental interpretation is not the concern of people in the core of the organization. These people process large amounts of information when tasks are

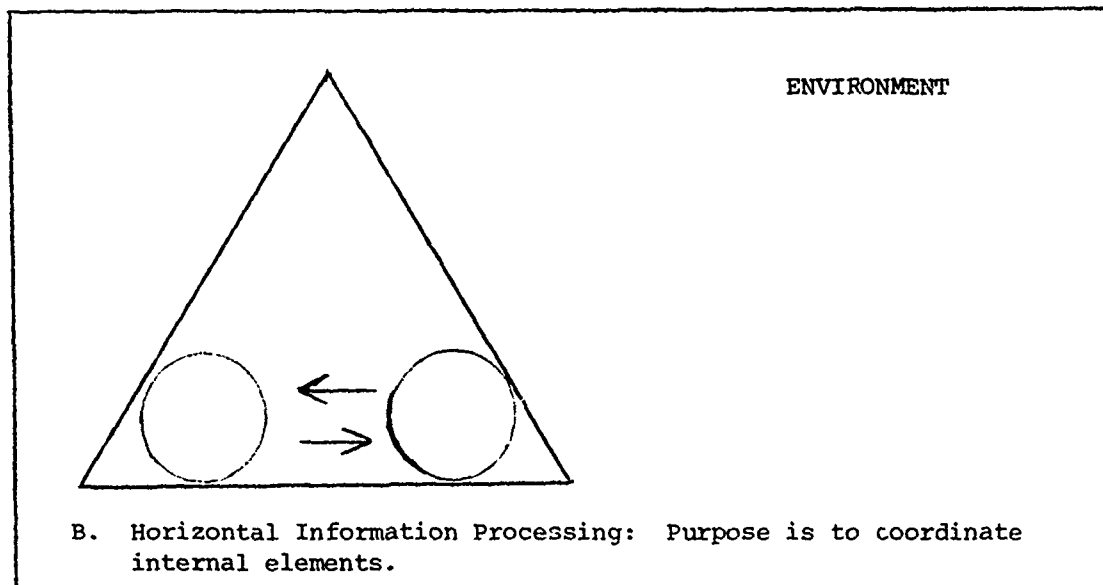
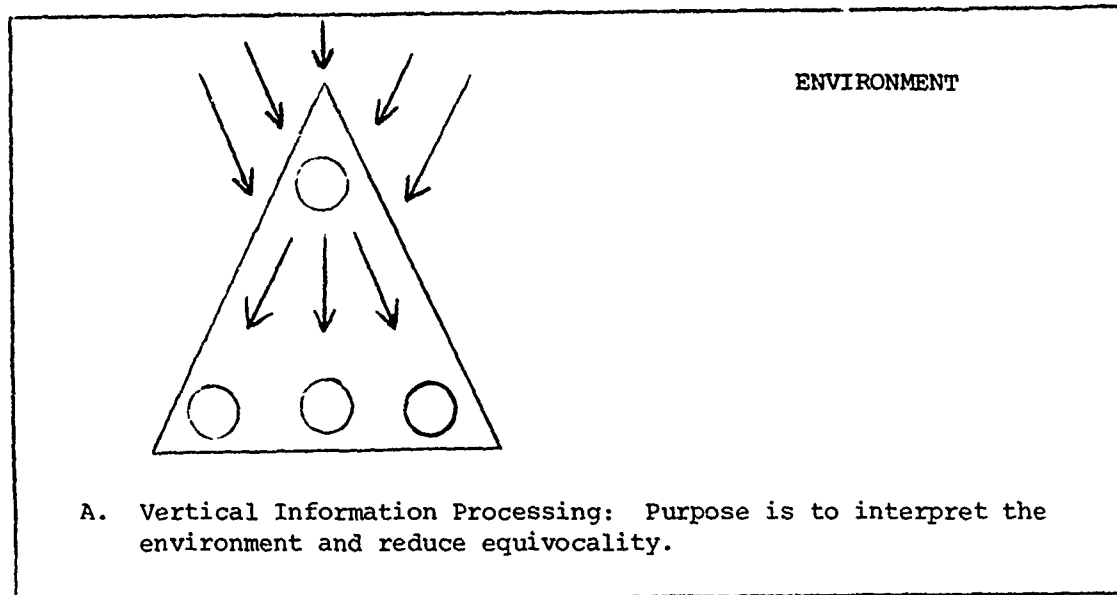


Figure 4. Vertical and horizontal information processing in organizations.

variable and activities are interdependent.

Figure 4 illustrates the two types of information requirements facing organizations. Organizations must both interpret the environment and coordinate tasks internally. As we will see, these two information needs are resolved in organizations through the use of rich information.

(Figure 4 about here)

Information tasks. Within the organization as a whole, a range of tasks are performed. Organizations use a technology to produce goods or services, and organizations work within an environment that is more or less uncertain. Organizational activities--in the broadest sense--impose specific information processing requirements associated with organizational technology, environment, and interdependencies (Poole, 1978). One information task is to reduce equivocality to the point where participants establish a shared view of events. The other task is to process sufficient amounts of information to enable internal coordination and task performance. These two information tasks represent the vertical and horizontal dimensions in figure 4.

The importance of these two information processing tasks for human organizations can be seen in the comparison to other types of systems that also use information. Boulding (1956) proposed a hierarchy of system complexity that ranged from simple frameworks through control systems, cells, plants, animals, human beings to social systems (Pondy and Mitroff, 1979; Daft and Wiginton, 1979). Social systems are the most complex systems in the hierarchy. Figure 5 shows an abbreviated hierarchy of system complexity with 4 levels.

For machine systems at level one, the two information tasks are easy to resolve. Physical systems are usually closed off from the external en-

vironment, so little interpretation is necessary. Most knowledge required for performance is built into the physical structure of the system. In a machine system (e.g. clock, assembly line) internal elements are coordinated through physical linkages. In the case of the solar system, elements are linked by gravity, so that information processing is not required. For control type systems (e.g. thermostat), simple coordination data may be transmitted in response to predefined environmental stimuli (e.g. temperature). But this data is unequivocal and is processed in relatively small amounts compared to higher level systems.

Biological systems (level 2) require a greater amount of information processing than physical systems. Biological organisms are differentiated, so data must be communicated among cells, organs and life sustaining sub-systems. For an advanced specie, a large amount of data would have to be processed on a continuous basis to enable physically differentiated sub-systems to function congruently. Biological organisms also are open systems, so senses are used to interpret the environment. For the most part, however, environmental interpretation is unequivocal. Flowers sense and respond in a predictable way to sunlight. Birds and insects respond in an almost programmed way to environmental changes in weather, seasons, temperature, or location.

(Figure 5 about here)

The internal information task for the human being (level 3) is similar to biological organisms at level 2. The human being is highly differentiated, so large amounts of data are transmitted among internal systems, although these data are typically unequivocal. Interpretation of the environment, however, is equivocal. In only a few instances, such as putting one's hand on a stove, is the stimulus unequivocal and the response predictable.

System Type		INFORMATION TASK	
		Amount Processed	Equivocality Reduction
<div>Complex</div> <div>↑</div> <div>Simple</div>	Social System	Interpretation: High Coordination: High	High High
	Human Being	Interpretation: High Coordination: High	High Low
	Biological System	Interpretation: Mod Coordination: Mod	Low Low
	Machine System	Interpretation: Low Coordination: Low	Low Low

Figure 5. System complexity and information tasks.

The majority of stimuli contain ambiguity. The external environment is alive with sounds, observed behavior, music, language, and symbols of all types. Most of these phenomena have multiple interpretations. Knowledge on any single topic is incomplete. People act on scraps of information and form these scraps into coherent wholes (Weick and Daft, 1982). The ability to process and interpret equivocal stimuli from the environment is what distinguishes human beings from lower level systems.

The most complex system of all is the human social system (level 4). The human being is the building block of the social system. The information problem of interpreting the environment is similar to interpretation by individual human beings. Upper-level managers must respond to an uncertain, ill-defined environment, and define with some certainty a course of action for others within the organization.

Human organizations must also process information internally. Internal information must coordinate diverse activities as discussed by Galbraith, which may require enormous amounts of data, especially when the task is uncertain and the organization is complex. Internal coordination in a social system is also equivocal, a point not incorporated in Galbraith's framework. Organizational specialization and differentiation lead to autonomy among subgroups. Group participants have divergent frames of reference. They attend to their own tasks, use common jargon, and pursue group level goals. Information transmitted across departments often is not clear or easily understood. Ambiguities arise, especially when differences among departments is great. Disagreements will occur.

We propose in figure 5 that critical information tasks in organizations are to meet the need for a large amount of information and to reduce equivocality.

The need to process equivocal information both within the organization and from the environment is what distinguishes social systems from lower level systems. Unlike machine or biological systems, internal data can be fuzzy and ill-defined. Diverse goals and frames of reference influence information processing. The organization must be designed to reduce equivocality both from within and without. A model of organizational information processing that treats organizations as higher level social systems should explain the reduction of equivocality as well as the correct information amount. Concepts and models of organization design based on information richness that explain these two information tasks are developed in the remainder of this chapter.

Vertical Informatic Model

Hierarchical level. The information task of reducing equivocality is a function of hierarchical level. At the top of the organization, the manager's world is subjective. Problems are fuzzy, complex, and poorly understood. Top managers shape reality for the rest of the organization. They decide goals and strategy, and influence internal culture (Pfeffer, 1981). Top managers create and maintain a shared belief and interpretation system among themselves. They have few objective facts. They must confront uncertainty, make sense of it, and attempt to communicate order and meaning to the lower levels of the organization. Managers use symbols, metaphors, speeches, body language, and other forms of rich information to communicate values, goals and culture throughout the organization.

At lower organization levels, the need to reduce equivocality is minimal. The information task is objective. Employees and first-line supervisors can make use of policies, rules and regulations, formal authority,

and the physical requirements of technology to govern their activities. The employees at lower levels work within the defined plans, goals, and technology of the organization. Interpretation is less equivocal. Information can be processed through less rich media and still convey relevant task information.

The equivocal information task along the hierarchy corresponds roughly to media usage, as illustrated in figure 6. High rich media, such as face-to-face and telephone will dominate at the top management level. Issues here are complex and ill-defined, such as the relationship between the institution and the environment. Middle management works within a somewhat more well defined structure. High rich media will still be used, but paperwork, documentation and other forms of less rich data will also be processed. The lower levels are more objective. People within the technical core, for example, will make frequent use of numeric and written reports. To some extent, all media will be used at each level. But rich media will play a more prominent role in the interpretation of the environment and reduction of equivocality at the top level, while less rich media will play a more important role for lower level employees.

(Figure 6 about here)

Richness Reduction. The information media used at each level is not random, but reflects the underlying process of organizing. Organizations must reduce subjectivity and equivocality (Weick, 1979). Organizations move from high rich media at the interface with the environment to low rich media with the technical core. Top managers use rich media to discuss, analyze and interpret the external environment, and to develop goals and strategies. These interpretations can be translated into less rich policies, paperwork, rules and procedures for use at middle and lower organization levels. Organizations reduce equivocality through the use of sequentially less rich media

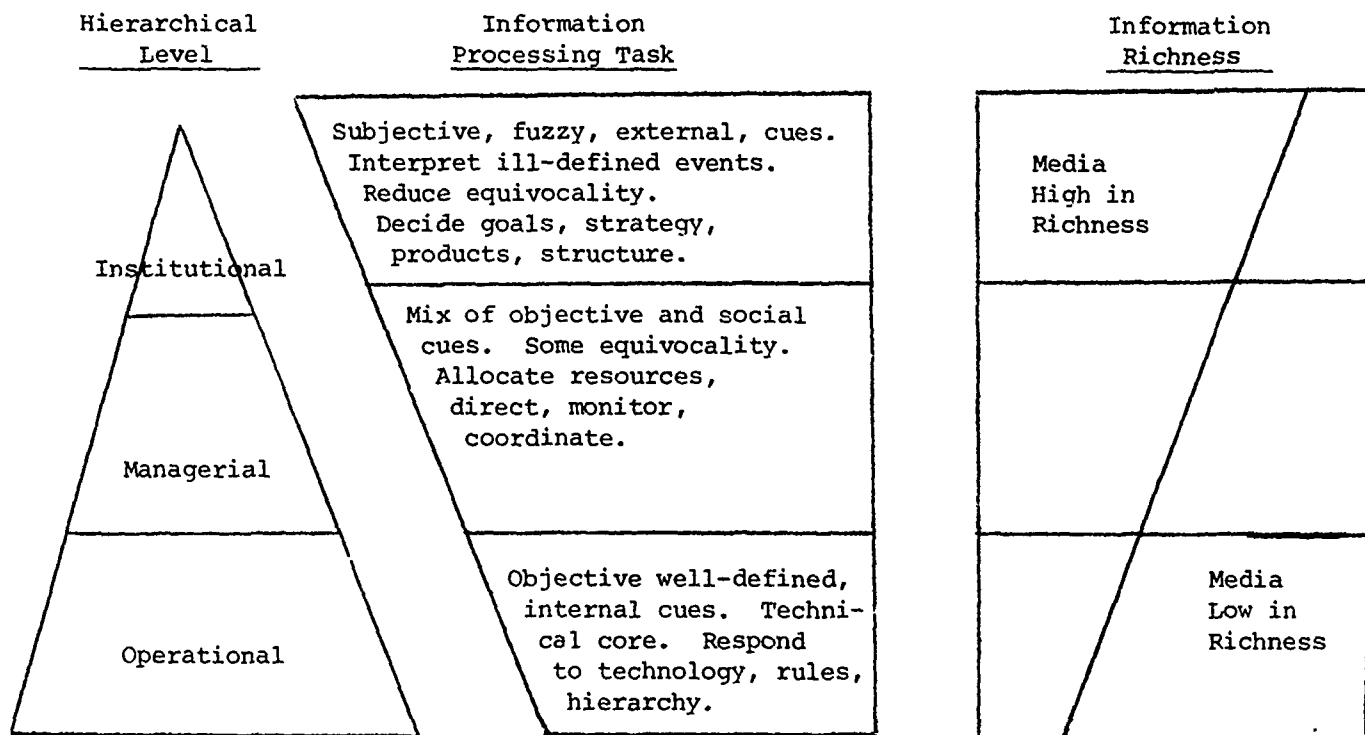


Figure 6. Hierarchical level and information richness.

down through the hierarchy. Reducing media richness is one way organizations reduce equivocality. Employees within the organization are thereby given a sense of specific roles, tasks, and purpose, and are able to perform efficiently without having to interpret and define messy external issues. When organizations adapt to external changes, or when top managers develop new interpretations, the results work their way down through the organization in the form of new technologies, products, procedures, and reports.

The dynamic of richness reduction is illustrated in figure 7. High rich media are used by top managers to cope with an equivocal information processing tasks. Low rich media is appropriate for the technical core. The diagonal in figure 7 represents the extent to which the organizational context is objective or subjective. As top managers interpret the subjective environment and come to common definitions through the use of face-to-face discussions, they are able to reduce equivocality and provide greater objectivity for lower levels. Richness and equivocality are simultaneously reduced. Information processing inside the organization contains less equivocality and information tasks require less rich media.

(Figure 7 about here)

The information processing that took place after the tornado in Elkhart, Oklahoma is a perfect example of the richness reduction process in figure 7. City administrators were hit with an unexpected event that created a highly equivocal information task. They used rich media--continuous face-to-face discussion and personal observation--to interpret and define the environmental situation. As they began to understand and reach a common definition of the situation, administrators provided a more well defined course of action for volunteers who were assigned objective tasks

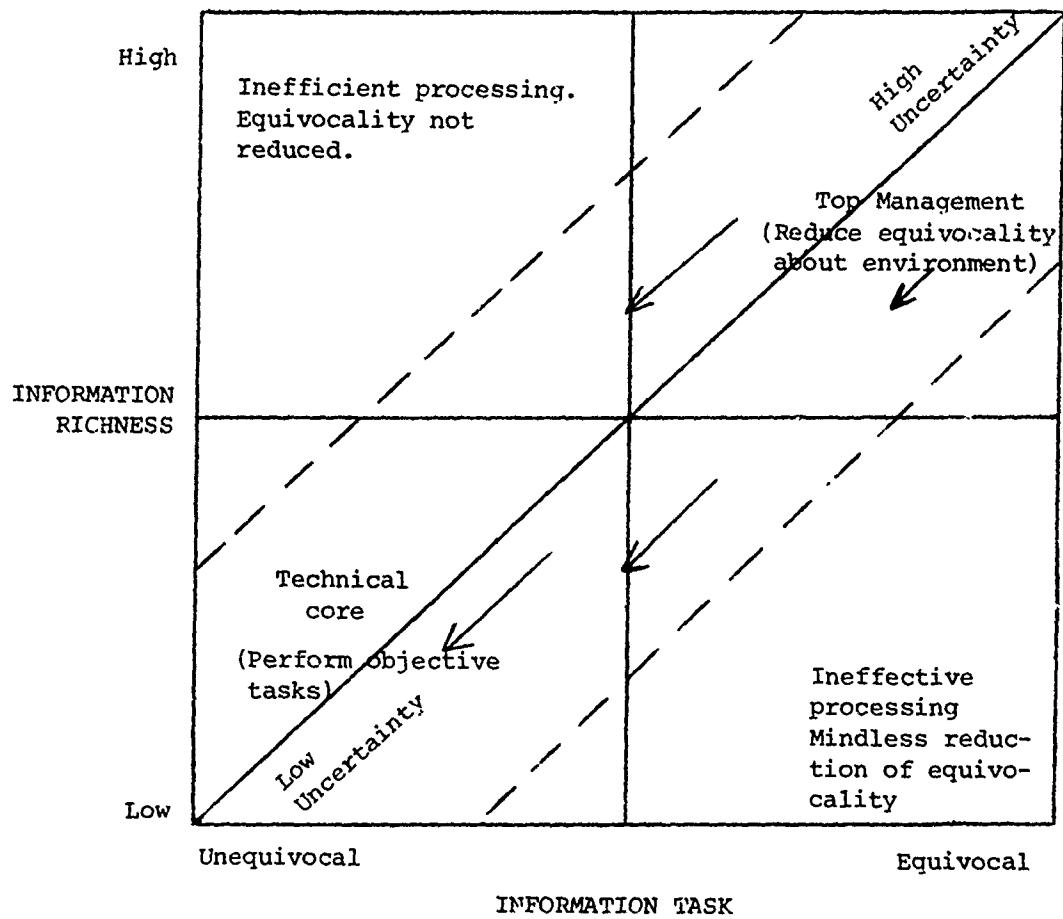


Figure 7. Process of equivocality reduction in organizations.

as the act of organizing progressed. As Weick argued, uncertainty triggers the act of organizing. People cluster around the equivocal event and pool ideas and perceptions. This information should be processed through media of high richness until equivocality is reduced to an acceptable level so that less rich media can be used to communicate specific goals and tasks.

Information processing which takes place outside the diagonal in figure 7 will not serve the organization well. In those cases where the organizations use rich media to resolve unequivocal issues, the organizing process will be inefficient. Face-to-face discussions to process routine and well-understood events will confound rather than clarify. Participants will feel uninvolved because the equivocality that triggers discussion is not present. Face-to-face meetings will not serve a purpose or help resolve problems. On the other hand, when the organization inadvertently uses media low in richness to process equivocal information, the organization's interpretation will be ineffective. This would be the case when equivocal events are arbitrarily quantified and fed into computers for reports to top management. The equivocality reduction will not reflect the consensus among management, and will not be the outcome of diverse perspectives forged into a common grammar. This is analogous to what happened in the business school example at the beginning of this chapter. A number was assigned to the complex research record of professors. The numbers were assigned prematurely because department heads had not developed a common perspective and evaluation criteria thorough discussion. The richness reduction process was short circuited, and the resulting information was inaccurate.

The implication for organization design is that information media should fit the vertical information task. Environments change. They

can be hard to analyze. Organizations should stay open to the environment. They do that by using rich media at the top. Senior managers maintain personal contacts in key external domains and use personal observation. Within the organization, top management should undertake informal discussions on unclear events. Executives can pool perspectives and build a common interpretation that will guide organizational activities.

As shared interpretations develop, the outcomes can be transmitted downward through less rich media. This creates certainty for lower level participants. Top management absorbs uncertainty through rich media, thereby enabling other employees to concentrate on production efficiency. To have everyone involved in equivocality reduction would be inefficient. Likewise, reliance on paper media by top management would close off the organization from the environment. Media of low richness do not transmit adequate cues to interpret the environment and do not permit managers to establish a common view and grammar.

Horizontal Information Model

Galbraith's (1973, 1977) model of organization design specified structural devices to handle internal information processing. Computers, assistants-to, and information systems can be used to process data within organizations. Galbraith also specified structural devices for horizontal communications, including direct contact among managers, liaison roles, teams, task forces, and full time integrators. Any of these devices might be implemented depending upon amount of information needed within the organization.

We propose that one horizontal information task within organizations is to reduce equivocality, which Galbraith's model did not incorporate. A department in an organization is a system within a system. Each department

develops its own functional specialization, time horizon, goals, (Lawrence and Lorsch, 1967), language, and frame of reference. Bridging wide differences across departments is a complex and equivocal problem. The perspectives of marketing and R&D departments, for example, are more divergent than between industrial engineering and mechanical engineering. Coordination devices in the organization must not only match requirements for information amount, but must enable managers to overcome differences in values, goals, and frames of reference.

Information processing between departments has two purposes--reducing equivocality and providing sufficient amount for task performance. Equivocality reduction is required by different frames of reference, which is similar to what Lawrence and Lorsch (1967) called differentiation. The amount of information needed between departments is determined by interdependence. The greater the interdependence between departments, the greater coordination required. When frames of reference differ, coordination activities also involve equivocality reduction.

Rich information is needed when information is processed to overcome different frames of reference across departments. Managers must meet face-to-face, discuss their assumptions, goals, and needs, and develop a common language and framework with which to solve problems. In the initial stages of a new product, managers from research, marketing, and production would have to resolve their differences and reach agreement through task forces or committee meetings. Once these differences are resolved, less rich media can satisfy information requirements. Progress toward a common goal could be plotted on a PERT chart, or data could be communicated with reports or other documents.

The decision process in the business college to give super raises across departments was an example of diverse frames of references. Each department had a different view on research quality. Rich media were needed to resolve

these differences and achieve a common perspective for allocating raises. When the business college used face-to-face discussion to achieve a common grammar and perspective, the decision outcome was satisfactory to participants. However, when department heads used media low in richness (written description, numeric ratings) to resolve differences and make recommendations, coordination was not successful. Differences across departments were not integrated into a common grammar. Equivocality had not been resolved to the point where less rich media could be used. Only after a common perspective is established will paperwork and numerical ratings be accurate.

Interdependence determines the amount of information that must be processed between departments. As information amount increases, devices will be utilized that enable large amounts of data to be transmitted. An occasional telephone discussion between managers may be sufficient in the case of low interdependence. A daily meeting of a task force may be required when interdependence is great.

The ideas for horizontal information processing are summarized in figure 8. Two problems must be faced--frames of reference and interdependence. The need to reduce equivocality is caused by divergent frames of reference that require rich media to resolve. Once a common language and perspective have been established between departments, less rich media such as memos, paperwork, and reports can be used for coordination. As the interdependence between departments increases, devices must be in place to allow sufficient volume of information to be processed, otherwise organizational performance may suffer.

(Figure 8 about here)

Devices such as full time integrators, integrating departments, and the matrix organization provide both rich media and large amounts of information (cell 2). These structural devices are required when organizational depart-

<p>High</p> <p>DIFFERENCE BETWEEN DEPARTMENTS (frames of reference)</p> <p>Low</p>	<p>1. <u>High Difference, Low Interdependence</u></p> <p>a. Media high in richness to reduce equivocality.</p> <p>b. Small amount of information.</p> <p><u>Examples:</u> Occasional face-to-face or telephone meetings, personal memos, planning.</p>	<p>2. <u>High Difference, High Interdependence</u></p> <p>a. Media high in richness to reduce equivocality.</p> <p>b. Large amount of information to handle interdependence.</p> <p><u>Examples:</u> Full time integrators, task force, project team.</p>
	<p>3. <u>Low Difference, Low Interdependence</u></p> <p>a. Media low in richness.</p> <p>b. Small amount of information.</p> <p><u>Examples:</u> Rules, Standard operating procedures.</p>	<p>4. <u>Low Difference, High Interdependence</u></p> <p>a. Media low in richness.</p> <p>b. Large amount of information to handle interdependence.</p> <p><u>Examples:</u> Plans, reports, update data bases, MIS's, clerical help, pert charts, budgets.</p>

High

INTERDEPENDENCE BETWEEN DEPARTMENTS

Low

Figure 8. Relationship between interdepartmental characteristics and coordination devices.

ments are highly interdependent, yet highly specialized with distinct technologies and frames of reference. When interdependence is high but differences are small (cell 4), information can be processed with less rich media. Written reports, data bases, formal information systems, letters and memos will provide sufficient information for coordination. Clerical staff could be used to process more information through the paperwork system of the organization.

In the case of divergent frames of reference and low interdependence (cell 1), direct contact between departments can be used as needed. Face-to-face meetings would resolve differences, but would only be needed occasionally. Only a small amount of time and data would be processed in this situation. Finally, when differences and interdependence are both low (cell 3), coordination is a minor problem. Standing rules and procedures will be sufficient to accommodate any differences and information needs that exist.

The implication for organization design is that horizontal coordination devices should accommodate the dual needs of equivocality reduction and information amount. Different departmental frames of reference increase equivocality, hence the organization should design devices to process rich information and reduce equivocality in order to facilitate coordination. High interdependence between departments requires a large amount of information, so devices should be designed for sufficient volume of information to facilitate coordination. organization design that achieves the correct amount of both equivocality reduction and information amount between departments will experience effective coordination, and hence high performance.

Research Evidence on Vertical and Horizontal Information Models

In this section we will briefly review research evidence on information processing by organizations. Research pertaining to interpretation of the

environment (vertical model) is considered first, then evidence concerning internal coordination (horizontal model) will be discussed.

Vertical Model.

One surprise in the literature on interpretation of the environment is that so few studies have been reported. Virtually all writers agree that organizations are open systems that must monitor the external environment. Yet studies of this process are notably sparse (Pfeffer and Salancik, 1978). The specific evidence sought for this section is whether organizations use rich media to interpret the environment, and whether interpretations are then translated through less rich media to provide greater certainty at lower organization levels. The task of equivocality reduction is expected to diminish at lower hierarchical levels.

Hierarchical Level. Parsons (1960) proposed three levels of decision making in the organizational hierarchy--institutional, managerial and operational. These three levels were illustrated in figure 6. The institutional level is the top of the organization, where the primary task is to set broad goals, and to decide the organization's products, technology, policy, strategy, and relationship with the external environment. The managerial level is the middle level in the organization. The requirement here is to plan and direct the activities of the organization and coordinate tasks laterally. This level is concerned with day-to-day management of organizational affairs. The technical level is at the bottom of the organizational hierarchy. At this level the operational work of the organization is accomplished.

Preliminary evidence indicates that the problems confronting the organization differ by level. Brightman (1978) argued that problems differ in uncertainty, complexity, and political nature. Problems at the top tend to be less programmed than decisions at the bottom. Stimuli at the top are less well

structured (Leifer, 1979; Brightman, 1978). While there may be a few routine elements, managers at the top have to deal with economic, legal, political, and social factors that are hard to analyze and define. They also must anticipate the impact of these factors on the organization and consider possible responses. Problems within the organization, although they are sometimes ill-structured, generally reflect a greater proportion of routine and well understood stimuli (Leifer, 1979).

Is the difference in organizational levels associated with information richness? Leifer (1979) argued that inputs at the top of the organization tend to be informational while inputs used at the lower levels were data. Data tend to be more quantitative, objective, and less rich than the personal, subjective information used by top managers. Kefalas and Schoderbeck (1973) found that upper level executives spent more time gathering information about the environment than those at the lower levels. Gorry and Scott (1971) also proposed that information characteristics at the upper level tend to be broad and less accurate. These data are richer than the detailed, well defined, narrow data used at lower levels. Finally, the literature on management information systems reviewed earlier concerning manager information behavior (Dickson, Senn, Cheway, 1977; Tushman and Nadler, 1977; Higgins and Finn, 1977) suggested the formal systems were not used by top managers. MIS's are a low rich medium, and are more useful for well defined activities at lower hierarchical levels.

Scanning. Scanning pertains to the organization's intelligence gathering mechanisms. Most environmental scanning takes place at the upper levels of the organization (Aiken and Hage, 1972). The few studies which have actually observed scanning behavior indicated that most scanning utilizes rich media. Aguilar (1967) compared personal to impersonal

sources about the environment. He found that personal sources were of much greater importance to executives than impersonal material. Keegan (1967) compared human to documentary sources of information used by headquarters executives in multinational companies. He found that two-thirds of information episodes were with human sources. The businessmen he studied used a network of human contacts in a variety of organizations to interpret the international environment. Documentary sources, such as the Wall Street Journal and the New York Times, were read regularly by the executives, but were less influential sources of information.

Bauer, Pool, and Dexter (1964) concluded that to a large degree American business communication is oral or by personal memorandum. Allen (1966) studied information sources for engineering decisions, and found that customers and vendors were the most used information source. Engineers had personal contact with these people to provide information on such things as new product needs. The formal literature, by contrast, was the least used source for this information.

The Keegan (1976) and Allen (1966) studies also indicated that information media reflect the nature of the underlying task. Keegan found that financial executives were more likely to use documentary sources, which is consistent with the well understood nature of accounting systems. General management and marketing, which experienced greater change and uncertainty, made greater use of human sources. Allen found that scientists who were working on well specified research problems made greater use of literature sources than did engineers who were involved in new product development.

Another source of information for top executives is personal observation. This is very rich medium. It is not unusual for executives to

take special tours, which involve face-to-face meetings with subordinates and the observation of facilities (Mintzberg, 1973). Rich media provide greater insight into the organizational needs and problems than would be obtained by relying on letters or formal documentation (Keegan, 1976).

Kefalas (1975) reported a survey of scanning activities by managers in farm-equipment and meat packing companies. He found that upper-level executives devoted more time to scanning the external environment than did lower level managers. The source of scanning information was primarily face-to-face meetings with other people. Moreover, executives spent more time scanning the environment when it was dynamic rather than stable. The dynamic environment represented greater uncertainty and complexity, which was associated with greater use of rich media.

Conclusions reached independently by Keegan (1976) and Kefalas (1975) revealed the small role played by formal paperwork for senior managers. Keegan's study included fifty executives who each reported three communication incidents. Computer-based or quantitative reports were not reported in a single case as the source of external information. In much the same fashion, Kefalas found that formal surveillance received very little emphasis in organizations. Many businesses support organized technological and market research activities, but this data is not widely used within the organization. These systems are sometimes haphazardly designed so that information is not always available to the right people. These systems also fail to capture the novel and unstructured aspects of the external environment.

Summary. There has not been a great deal of research on the relationship between media richness and hierarchical level, but a reasonable inference is that the relationship proposed in figure 6 receives modest

support. Upper level management activities differ systematically from lower level activities, and upper level managers make extensive use of rich media to interpret and understand the external environment. Personal contacts appear to be essential for interpreting the external environment and reducing equivocality. Organizations undergo a process of richness reduction from the top to the lower levels of the organization. Rules, procedure, job descriptions, technical reports, and other forms of less rich media are more widely used at lower organizational levels. Rich information media are used for interpretation and decision making at the top, and sequentially less rich media are implemented at lower levels. Variation in media richness helps explain how equivocality reduction necessary for survival and efficient internal performance takes place.

Horizontal Model

A number of studies have examined communication and information processing inside organizations. Research relevant to the information richness models in figures 7 and 8 are in the categories of technology, interdependence and internal culture.

Technology. Technology is a source of uncertainty for employees within the organization, and thus influences information processing. Empirical studies have indicated that complex, nonroutine tasks require more information processing than simple, routine tasks. This relationship has been observed in small groups (Bavelas, 1950), stimulated organizations (Becker and Baloff, 1969), research and development groups (Tushman, 1978, 1979), and other organizational departments (Van de Ven and Ferry, 1979; Randolph, 1978; Daft and MacIntosh, 1980).

Relevant to the theory presented in this chapter is evidence that media usage is associated with technological uncertainty. Woodward's (1965)

seminal study of organizational technology found that communication media changed according to complexity of the task. People in highly routinized mass production organizations tended to rely on written communication and to have extensive formal procedures. Organizations that had less clear technology, such as continuous process or small batch, relied more on verbal media. The complexity of the task was associated with information media richness.

Studies by Van de Ven, et al (1976) and Daft and MacIntosh (1980) support this general relationship. Van de Ven, et al found that when task uncertainty was high, managers made more frequent use of unscheduled meetings and other forms of horizontal communications. When task uncertainty was low, rules and plans were the primary means of communicating. Daft and Macintosh reported that when tasks were less analyzable, participants preferred less precise information. Information had greater equivocality and required personal experience to interpret and use to solve the unanalyzable problems.

Meissner (1969) found that as technology varied from uncertain to certain, the media used by employees shifted from verbal to objective signs and written communications. Randolph (1978) observed that verbal media were used more frequently as technology increased in uncertainty. He also observed a shift from verbal to horizontal communication. Finally, Gaston (1972) found that nonstandardized tasks were associated with more face-to-face information transfer than were standardized tasks.

The communication patterns associated with technological uncertainty are consistent with our proposed models of information processing. The forms of communication observed by Woodward (1965), Van de Ven, et al (1976), Daft and Macintosh (1980), Meissner (1969), Randolph (1978) and Gaston (1972)

can be interpreted to reflect differences in the continuum of information media. Media high in richness (face-to-face, personal contact) were used when tasks were complex and uncertain. Media low in richness (rules, regulations, written) were used when tasks were simple and certain.

Interdependence. There have been fewer studies of interdependence, but the general direction of findings seems to be similar (Tushman and Nadler, 1978). As interdependence increases, the need for communication between groups increases, so the amount of information processed to achieve coordination increases (Van de Ven, Delbecq, and Koenig, 1976).

Interdependence is also related to media richness. Thompson (1967) argued that when interdependence increased from pooled to sequential to reciprocal, techniques of coordination should change from rules to standardization to mutual adjustment. These coordination techniques are changes in media. Rules do not convey rich information, but mutual adjustment (face-to-face) is very rich. Van de Ven, et al (1976) also found that communication shifted from rules to meetings as interdependence among employees increased. This finding also fits the richness model in figure 8.

We theorized that differences in frames of reference across departments would require high rich media to resolve. This idea receives modest support from the research of Lawrence and Lorsch (1967), who found that personal modes of coordination were used when differentiation within organizations was high. However, their study did not compare personal to impersonal media. The lateral information processing they found was face-to-face, which suggests the need for high rich media to accommodate divergent frames of reference and perspectives.

Internal Culture. Organizational culture and climate may also be

associated with information media. There is intriguing evidence to suggest that myths, stories, and metaphors are effective means of preserving social and emotional aspects of organization (Boje and Rowland, 1977; Clark, 1972; Meyer and Rowan, 1977; Mitroff and Kilman, 1976). Myths, legends, sagas, and stories are prevalent in most organizations. These stories usually pertain to the socio-emotional side of the organization and provide employees with history, background, and meaning for their role within the organization.

Myths and sagas are not written down, and if they were, their usefulness might be lost. A similar finding is true for gossip and the use of the grapevine (Davis, 1953). Information processed along the grapevine generally is of a personal nature and is communicated through rich media. The reason is that stories, myths and gossip pertain to the ill-defined, emotional aspects of organization that are best transferred through informal, personal media. Transmitting myths or gossip through informal, impersonal media would transform the stories into rational facts, and they would no longer pertain to the deeper, emotional needs of participants.

Summary. Once again, evidence from the research literature provides tentative support for the theoretical ideas expressed in this chapter. The findings suggest that rich media tend to be used when tasks are complex, and when differences between departments are great. Task complexity and interdependence are also related to information amount.

Taken together, these findings may mean there is a positive relationship between media richness and amount of information processed, since both seem to increase with task complexity and interdependence. The face-to-face medium, for example, enables managers to process rich information cues. Cues conveys more insight, so managers actually acquire more information

to understand a complex issue or develop a new cognitive map. Amount of information may be increased by spending more time communicating or by shifting to richer media. The general conclusion is that requirements for horizontal information processing influence both richness and amount of information. Organizational design should enable the appropriate amount of information to be processed, and should provide managers with appropriate media richness depending on task uncertainty and interdependence.

DISCUSSION AND IMPLICATIONS

Early in this chapter, we proposed that organizational success is related to the organization's ability to manage information richness. Information richness was defined, and three models were proposed. The major points contained in this chapter are as follows.

1. Information is a core construct for understanding organizational form and process.
2. Human organizations, unlike lower level systems, must use information to reduce equivocality.
3. Organizations have two information related tasks, which are to interpret the external environment and to coordinate internal activities. Each of these tasks requires the reduction of equivocality and the processing of a sufficient amount of information.
4. Information richness is an important concept for explaining how organizations perform the task of reducing equivocality to an acceptable level for internal efficiency. Rich media utilize multiple cues, feedback, and high variety language. Rich media enable people to interpret and reach agreement about difficult, unanalyzable, emotional, and conflict-laden issues. Face-to-face discussions lead to a shared language and interpretation. Media of low richness are appropriate for communicating about routine activities within the organization. Paperwork, rules, and computer print-

outs are accurate and efficient for the transmission of unequivocal messages.

5. Media richness is the basis for the model of manager information processing behavior. For difficult, equivocal topics, managers use face-to-face discussion for interpretation and equivocality reduction. Memos, bulletins, reports and other media of lower richness are used when the topic is specific and better understood. In a sense, there are two sides to managerial communication. Managers use informal, personal, direct contact when problems are ambiguous and unclear. They use formal, paperwork communications for routine matters. Effective managers should have skills with all media and be able to select among them depending on the nature of the problem.

6. Media richness also explains how organizations interpret the external environment, as described in the vertical information model. Media selection enables the organization to learn about an uncertain environment, yet provide a sense of certainty and direction for participants within. Face-to-face and other rich media are used to receive cues about the environment and to define a common grammar for use within the organization (Weick, 1979). The organization reduces media richness as information moves down the organizational hierarchy. Media of low richness can be used to specify goals, policies, procedures, and technology at lower levels, thereby providing clarity and certainty for the efficient performance of routine activities. The key to vertical information processing is to incorporate a balance of media. When the environment is uncertain and equivocal, rich media are called for. Organization design should encourage face-to-face discussion to reduce equivocality and provide certainty within the organization. When activities are stable and analyzable, less rich media should be

used.

7. Media richness is also the basis for the horizontal information model that explains how organizations coordinate internal activities. When departments are highly differentiated and interdependent, equivocality is high. When equivocality is high organizations will use rich information media to resolve departmental differences and to reach a common language and perspective. Once differences are resolved and agreement is reached, less rich forms of communication, such as memos and formal reports, will be sufficient for coordination. Media selection within the organization is related to the extent of differentiation and interdependence among departments.

Relationship To Other Frameworks

One outcome of the ideas described in this chapter is that they are consistent with other frameworks in the literature. Current perspectives can be reinterpreted in terms of media richness. Three frameworks--organic versus mechanistic organizations, bureaucracy, and politics--are considered here.

Organic Versus Mechanistic Organizations. The environment is a major source of uncertainty for organizations. Complexity, variability, and rate of change in the environment create additional uncertainty for managers in the organizations. Participants must spend more time finding out about the environment and adapting to changes in the environment.

Perhaps the most widely accepted relationship between organization and environment is that organic structures tend to evolve in uncertain environments, and mechanistic structures are suited to certain environments (Burns and Stalker, 1961). In an organic organization, people are continually re-

defining and renegotiating tasks. There is widespread discussion about activities. Rules and responsibilities are ill-defined or nonexistent. In a mechanistic organization, activities are more rigidly defined. Rules, regulations and job descriptions are available to control behavior. Task redefinition is nonexistent. Communication tends to be vertical rather than lateral.

We suggest that the principle difference between organic and mechanistic organizations is media richness. The organic structure facilitates communication through rich media. The organization is constantly learning. Changes in the external environment are being interpreted and translated into new roles and internal tasks. Widespread face-to-face discussion enables continuous interpretation and adaptation to take place. The process of richness reduction is minimized in the organic structure because the entire organization is involved in interpretation, discussion and change.

The mechanistic structure makes greater use of media low in richness. Rules, procedures, and job descriptions contain the information necessary for successful task accomplishment within the organization. An extensive reduction in richness from the top to the bottom of the organization is accomplished. A small percentage of people are involved in environmental interpretation. Rules and regulations enable the organization to respond from habit and previous experience rather than through new interpretations. Formal media are appropriate in organizations that have well understood, predictable environments. Of course organic organizations would still utilize some low rich media and mechanistic organizations some high rich media. But rich media are used more extensively in organic organizations where the environment is changing and complex. Media low in richness are used more extensively in mechanistic organizations within stable environments.

Bureaucracy. Research on bureaucratic organizations has indicated that bureaucracy is similar to the mechanistic organizations studied by Burns and Stalker (1961). The literature suggests that as organizations increase in size, bureaucratic traits increase (Kimberly, 1976). Weberian characteristics such as division of labor, rules, and paperwork, are more extensive in large organizations (Blau and Schoenherr, 1971; Dewar and Hage, 1978).

These findings support the idea that richness reduction takes place. In a large organization, communication can be standardized, and relevant information is contained within the formal documentation of the organization. Large organizations develop a niche within the environment so that external conditions are relatively stable. Large organizations learn to take advantage of internal efficiencies by responding through habit or by buffering the technical core when external changes do occur.

Studies that show increased formalization and large clerical ratios with organization size support the reliance on information of lower richness (Daft, 1978; Kasarda, 1974). Formalization is a measure of the amount of documentary data in the organization. Large clerical ratios provide people to process large amounts of paperwork. Small administrative ratios in large organizations means the organization is run with less personal observation (rich media) and more by rules and regulations that act as substitutes for supervision. Media of low richness are substituted for media of high richness during bureaucratization. Even the increasing complexity in large organizations reflects information processing to some extent. An increasing number of departments and specialties is a way to divide the total information base needed for effective performance. Each department can develop a common language and frame of reference that will enable the

use of less rich media for task accomplishment.

Politics. Politics is defined as those activities used to obtain one's preferred outcome in organizations when there is uncertainty or disagreement about choices (Pfeffer, 1981). Recent surveys of organizational politics (Gantz and Murray, 1980; Madison, Allen, Porter, Ranwick, and Mayes, 1980) indicate that political behavior occurs most often at the upper levels of organizations and for certain types of decisions.

We propose that political behavior involves the utilization of rich media (face-to-face) to reach agreement when diverse goals and reference frames are brought to bear on uncertain problems. Disagreement is the result of diverse perspectives and goals across departments. Uncertainty is the result of the ill-defined nature of political issues. Politics is a device to encourage face-to-face discussion among a broad group of executives until a coalition is formed that reflects a common grammar and understanding. Media low in richness cannot be used to resolve political issues because paperwork and reports cannot convey the subtleties of power, obligations, and other intangibles. Politics is one vehicle through which rich media are used to reduce equivocality. Politics occurs both at upper levels and across departments when events are uncertain and reference frames diverge.

By contrast, rational models of decision making reflect the use of low rich media to process information and make decisions. The rational model is effective when factors are certain, and when participants agree on desired goals and cause-effect relationships (Pfeffer, 1981). The rational model makes use of documentary sources of information, such as statistics and quantitative analysis. This approach to information and decision making is used more often for operational and technical decisions

at lower levels in the organization.

Future Research Directions

The models in this chapter not only relate to the established frameworks above, they also can be the basis for a lengthy agenda of new empirical research. Very little research has been reported on topics such as the selection of media by managers, how organizations interpret the external environment, or the mechanisms used to process information horizontally between departments. A study by Lengel (1983) supports the underlying concept of a media richness and the relationship between media richness and the nature of communication topics. Additional studies based upon the models presented in this paper and beyond are suggested below.

Media selection and usage. The model of manager information processing in figure 3 might be tested in a number of ways. A large sample of communications typically sent and received via each medium could be obtained and analyzed for systematic differences in content. Managers might be asked to describe critical communication incidents and to describe the medium used. Another approach would be to systematically test the relationship between task complexity and media selection. A sample of communication episodes could be developed according to complexity, ambiguity, conflict, emotional content, and accessibility. Then managers could be surveyed to determine their media choice for each episode. Analysis of these data would indicate the extent to which task complexity influences media selection. These data could also be analyzed by manager effectiveness and manager hierarchical level to see if media selection is associated with manager differences. A study could also test these relationships in the laboratory. Specific topics would be communicated through various

media, such as telephone, face-to-face, and written. This research would indicate how media influence trust, understanding, and agreement among managers.

Boundary spanning. Pfeffer and Salancik (1978) proposed that organizations face two problems in relationship to the environment: (1) how to register needed information about the environment, and (2) how to act upon that information. The first problem is one of boundary spanning. Exploratory case type studies have been conducted by Aguilar (1967) and Keegan (1974), but systematic analyses of external information sources have not been published. An appropriate study would be to interview boundary spanning managers about information topics important to their functions. After two or three critical topics are identified, sources of information on these issues could be determined. External sources such as magazines, personal contacts, and opinion surveys can be identified. The transmission of information into the organizational decision center could also be traced. This study could begin with in-depth interviews of boundary spanning personnel, with a follow up questionnaire survey of information sources for specific topics. The outcome of this study would begin to shed new light on the intelligence gathering activities of formal organizations.

Interpretation and effectiveness. Weick and Daft (1982) proposed that organizations systematically differ with respect to interpretation style. Interpretation style is an outgrowth of boundary spanning activity, and includes the development of shared perception, goals, and strategies among top managers. In this study, senior managers could be interviewed to identify how they learn about the environment. The role of organization design, such as the existence of a formal department to scan and

analyze the environment, could also be analyzed. The effectiveness of interpretation systems could also be evaluated by direct comparison of several organizations in a similar environment. Organizations in the same industry that have differing levels of profit, innovation, or other outcomes can be evaluated for interpretation differences.

Interdepartmental coordination. Interdepartmental coordination pertains to horizontal information processing in organizations. Van de Ven, Delbecq and Koenig (1976) studied mechanisms used to coordinate members within a department. No studies have been conducted of coordination between departments or between major divisions of a large corporation. Galbraith's (1973, 1977) framework argues that coordination mechanisms reflect differences in information processing needs. A valuable study would examine these coordination processes in more detail. Specific coordination issues could be followed through the organization to learn how coordination was achieved. The model in figure 7 could be tested by observing the extent to which media richness is related to frames of reference or to the amount of interdependence between departments.

Equivocality reduction. The theme that underlies this entire chapter is equivocality reduction. Organizations must be able to translate uncertainty to certainty in order to achieve internal efficiency and stability (Skivington, 1982). Equivocality may originate in the external environment or through internal disagreements. Despite the importance of equivocality reduction to organizational interpretation and coordination, we know virtually nothing about it from an empirical perspective. The process of perceiving an equivocal stimuli, evaluating it, discussing it, and coming to a resolution could be the focus of new research. This

type of study might be conducted in either the laboratory or in the field. Groups or simulated organizations could be presented with an equivocal stimuli to observe how it is resolved. Specific environmental events might be traced into and through real organizations to learn how an acceptable level of understanding and certainty is reached. Almost any study of equivocality reduction, however exploratory and tentative, would discover significant new knowledge about organizations.

Symbolic value of media. Feldman and March (1981) proposed that information in organizations serves as signal and symbol. More information is gathered than organizations use, yet managers may request even more. Formal reports may not influence the rational decision process, but be used to support a course of action previously agreed upon. Feldman and March argued that the use of information is highly symbolic, and that information processing cannot be fully understood by considering only rational communication exchanges and decision making. The selection of media also may have strong symbolic overtones. Face-to-face discussion may be used when a manager wishes to communicate personal interest or to show others that he cares about them. Formal reports might be used to signal that extensive study lies behind a supposedly rational decision. Letters and memoranda convey a sense of the official and symbolize the legitimate role of the organization. The symbolic aspect of media could be assessed by identifying communication episodes and asking managers why they selected a specific medium. The deeper reasons for using media might be elicited through open-ended interviews. Similar interviews might be conducted with people who receive communications through various media. The deeper significance of media in the interpretation of messages could suggest new insights into the types of signals communicated within organizations.

CONCLUSION

This chapter has introduced the concept of information richness and proposed models of manager information processing, organizational interpretation, and internal coordination processes. The ideas in this chapter have attempted to integrate ideas and topics from the literature on organizations. These topics include manager preference for personal contact and informal information, sources of information used by managers in various tasks, the observation that organizations must reduce equivocality about the environment (Weick, 1979), and Galbraith's (1973) description of organization structure as a means of directing communication flows. The notion of information richness sheds light on all these activities. When the task is complex and difficult, rich media enable successful information sharing. The information richness model provides a way to understand the behavior of individual managers as well as to integrate the notions of equivocality reduction and internal coordination.

Any model involves tradeoffs and unavoidable weaknesses. Probably the greatest weakness in the models presented in this chapter is reflected in Thorngate's (1976) postulate of commensurate complexity. Thorngate states that a theory of social behavior cannot be simultaneously general, accurate, and simple. Two of the three are possible, but only at a loss to the third. The models in this paper are general and simple, and hence are not very precise at predicting details. The models represent frameworks that apply to organizations in general. More specific elaboration of the models can be developed after additional study and research.

The major conclusion from the paper is the need for organizations to manage information richness. Richness has to reflect the organization's need to interpret an uncertain environment and to achieve coordination

within. Organizations are complex social systems that have information needs unlike lower level machine and biological systems. Rich information will have to be processed because environments will never be certain and intern. conditions will never be characterized by complete agreement and understanding. Without some level of rich information, organizations would become rigid and brittle. They could not adapt to the environment or resolve internal disagreements in a satisfactory way. The process and outcomes of information processing are a good deal less tidy than would be the case in simpler, machine models of organizations. The ideas proposed in this chapter suggest a new view--perhaps a starting point of sorts--from which to interpret the richness of organizational activity.

Footnotes

1. The names in these examples are fictitious, but the examples are based on actual events.

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